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A
PRACTICAL TREATISE
ON
CHIMNEYS

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Founded 1876

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From information obtained from the British Museum Library it would appear that the following editions of this work were published :-

(1) First edition dated 1771. This edition is mentioned by the author in the introduction to the third edition. Neither the B.M. nor the Society has a copy of this edition.

(2) An edition dated 1776 published in Edinburgh. The B.M. has a copy of this (no. 1043 f 25) (?is this the second edition)

(3) An edition dated 1777 published in Dublin. The Society has a copy of this. (? Is this an Irish edition of the second edition)

(4) A Third edition dated 1783 (The British Museum has two copies of this - only one has been seen by the Society's staff)

The author's name only appears in the Third edition. The introduction to this volume gives information about the previous editions.

A
PRACTICAL TREATISE
ON
CHIMNEYS.

CONTAINING
FULL DIRECTIONS
FOR PREVENTING OR REMOVING
SMOKE IN HOUSES.

ILLUSTRATED WITH EIGHTEEN FIGURES

ENGRAVED ON COPPER.

D U B L I N:

PRINTED FOR JAMES WILLIAMS.

MDCCCLXXVII.

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C O N T E N T S.

	Page
<i>General observations,</i>	i

S E C T. I.

<i>Of Smoky Houses, occasioned by a fault in the Structure of the Chimney itself,</i>	5
<i>Plain directions to operative masons how to construct a chimney, so as most effectually to carry off the smoke,</i>	21

S E C T. II.

<i>Of Smoky Houses occasioned by faults in other parts of the building, altogether independent of the structure of the chimney itself,</i>	35
--	----

S E C T. III.

<i>Of Smoky Houses arising from a wrong position of the building with regard to external objects,</i>	51
<i>Short and easy rules, by which the different classes of Smoky Houses above mentioned may be distinguished from one another,</i>	56
<i>Anomalous Cases,</i>	57
<i>Hints to inexperienced architects, to enable them to distinguish and guard against those circumstances that have a natural tendency to occasion smoke, whether these arise from the position or internal division of the house,</i>	60

Directions to the BINDER.

Place the plate so as to front p. 60.

Make it to fold upwards, so as that when the book is opened, and the plate unfolded,—the top of the plate, and not the bottom, may go beyond the book.

The plate to be folded in a line between *a* - - -
and - - - - *z*.

A

PRACTICAL TREATISE

ON

SMOKY CHIMNEYS.

SMOKE is a dense elastic vapour, arising from burning bodies.

Although this is in general disagreeable to the human sensations, yet in some places, as the natives have no other method of freeing themselves from the attacks of innumerable insects, than by involving themselves in a cloud of thick smoke, they have thus gradually inured themselves to breathe it without intolerable inconvenience, and therefore are at no pains to free themselves from it. The Laplanders, and some other savage nations, have no other openings in their houses to emit the smoke than the doors and windows.

A

But

But as mankind advance in civilization, — as they become easy in their circumstances, and come to form a more adequate idea of enjoyment, — when they acquire an idea of cleanliness, and feel what a high degree of luxury it is to enjoy it, smoke in their houses becomes so exceedingly inconvenient, as to be accounted one of the greatest interruptions to domestic enjoyment, and is therefore excluded from their apartments with all possible care.

But if it is necessary in other parts of the world to exclude smoke merely for the sake of personal gratification, it becomes doubly so in Great Britain, and Ireland, where pit-coal is the most common sort of fuel, the smoke of which is not only disagreeable, but absolutely noxious, as many well-known facts too fatally declare.

To guard against these inconveniencies much ingenuity has been exerted ; and many contrivances have been adopted for effectually carrying off the smoke from our dwelling-houses : — but unfortunately these have been for the most part the inventions of men, who, being unacquainted with the physical causes of the ascent of vapour, were unable to distinguish with certainty those circumstances that were most essentially necessary for promoting the emission of smoke, or that tended most powerfully to prevent its going off in a proper manner : — hence their efforts have been chiefly directed to improper

ON SMOKY CHIMNEYS. 3

per objects ; — and the inhabitants of these islands feel to their cost, that in this age, when philosophy has lent its aid towards perfecting almost every other art, the builder of chimneys has been left to grope his way in the dark without an assistant ; and in almost every instance his attempts to improve upon the practice of his predecessors, have been unsuccessful ; so that the inhabitants of these countries, with justice, complain, that the inconveniencies felt in new houses from this cause, usually are more than sufficient to counterbalance all the elegancies that modern refinement has introduced into the dwellings of individuals.

In these circumstances it was imagined, that the author would perform a grateful service to many individuals, if he should, in a concise and perspicuous manner, explain all the circumstances that can promote or retard the ascent of smoke *in every case*, — point out the means of curing in the easiest and least expensive manner all chimneys that do not vent well, where they admit of a cure, — and instruct the operative mason how to construct new vents, in such a way as to carry off the smoke effectually in all cases whatever.

Such is the very important design of this little treatise ; — and the author is confident, that by duly attending to the following particulars, any one of ordinary capacity may be enabled to effectuate all these things with facility.

A 2

Although

Although it would seem natural enough at first sight to imagine, that the causes which produce smoke in rooms, are exceedingly various;—yet, upon a careful examination, it will be found, that they may be all reduced to one of the three following general classes :

1. A faulty construction of the tube,—vent, or chimney itself;

2. To some fault in the other parts of the building, and a wrong position of the chimney with respect to these; or,

3. To an improper situation of the house with respect to external objects.

As it is of the utmost consequence, in our attempts either to prevent or to cure houses from being pestered with smoke, accurately to distinguish from which of these defects the smoke proceeds, it is necessary to point out with care the several phenomena that are peculiar to each, that the reader may be able to remark them easily.

SECTION I.

Of Smoky Houses, occasioned by a fault in the Structure of the Chimney itself.

TO make the reader comprehend more clearly the several particulars relating to this branch of our subject, it will be necessary to explain the general principles upon which smoke is made to ascend in chimneys of any sort.

The earth is every where surrounded with a great body of air, that is called the *atmosphere*. This air is a thin elastic fluid, possessing some qualities peculiar to itself, but subjected in general to the same physical laws with other fluids; and of consequence it hath a constant tendency to preserve an exact equilibrium in all its parts; so that if at any time the weight of it at one place is diminished, the heavier air rushes from all sides towards that point, till the equilibrium be again restored.

Many are the causes that may tend to destroy this equilibrium of the atmosphere; but the only one that it imports our present discussion to explain the effects of, is heat.

When heat acts upon the air, it immediately makes it expand to a great degree, so as that the
same

6 ON SMOKY CHIMNEYS.

same quantity of it occupies a much larger space than formerly *. Hence it necessarily follows, that where a fire is kindled, the air immediately contiguous to it will be heated, and of consequence rarefied, and made lighter, bulk for bulk, than it was before.

But as it is an invariable rule among all fluids, that those which are lightest rise upwards, and at length swim upon the top of such as are more weighty, as oil above water, &c. so it as invariably happens, that when any particles of the same fluid are accidentally rendered lighter, or more weighty, than other parts of the same fluid, they either rise to the top, and give place to the more dense and weighty parts of it, or sink to the bottom, and force the warmer fluid to the surface. —It is owing to this cause that the water at the top of a caldron, before it begins to boil, is always as warm, or warmer, than what is below : —for the particles of water that touch the bottom, are no sooner acted upon by the heat below, than they become warmer, and more expanded, than those immediately above them; and therefore rise directly upwards, and give place to denser cold par-

* A familiar experiment may serve to give an idea of this expansion of the air by heat. —If a small quantity of air be tied up close in a wet bladder, and that be exposed to the heat of the fire, it immediately swells up, fills, and distends the bladder to a great degree; —and if long enough continued, it will at length burst the bladder with a great explosion.

ticles,

ticles, which are forced in their turn to ascend in like manner towards the top.

In the same manner it happens, that when the air contiguous to a fire is heated by its action, it is immediately expanded very much; and therefore instantly rises upwards, till it reaches the higher regions of the atmosphere, or is cooled by gradually mixing with the denser air it meets with in its ascent:—and as its place contiguous to the fire is immediately occupied by the cold dense air around it, which rushes from every side towards that point, it is heated and rarefied in its turn, and ascends in the same manner, carrying the smoke that rises from the burning body along with it.

It is in this manner that the constant suction of air towards every fire is produced; and from this cause proceeds the continual tendency of smoke to ascend from the surface of the earth, unless where some circumstance interrupts the course of nature.

But as fire could not conveniently be employed for the purposes of man in the open air,—so neither could the smoke be made to ascend to a proper height to prevent his being annoyed by it, unless in a perfect calm: for at other times the wind rushing violently along the surface of the earth, hurries the rarefied air and smoke along with it in its course, and mixes it with the gene-
ral

8 ON SMOKY CHIMNEYS.

ral body of the atmosphere before it can rise to any considerable height ; as any one who has ever given the slightest attention to this subject must have often observed.

It could not be long before men must have discovered, that when the fire was surrounded with a wall to any considerable height, the motion of the wind was interrupted by it, and the smoke allowed to rise upwards till it reached the top of the building.—The free ascent of this disagreeable vapour it would likewise soon be found was promoted by the addition of a roof ; which being convenient on other accounts, would be soon universally adopted.—Hence it happens, that in every part of the globe the first and most simple huts of savages are circular buildings, with a conical roof ; in the middle of which, for the most part, is left a hole for the emission of the smoke ; the fire having been placed in the centre of the building immediately below the opening, which served instead of a window, as well as a vent-hole for the smoke.

This form of huts is sufficient to accommodate mankind in the first stage of civil society ;—but as the useful arts encreased, and the human powers began to be developed, it was found that their habitations might be rendered more commodious, by adding some buildings beside the fire-place, and opening into it.—In these the inhabitants could sleep, and lay some of their household-utensils.

fls.—The fire-apartment being now no longer the whole of the house, there was no necessity for having it so large as formerly; and when it was gradually contracted to an inconsiderable size, it required very little exertion of genius to discover, that if the door that opened from thence into the adjoining apartment was made very large, the influence of the fire would pervade the whole of that apartment, while it could not be annoyed by the smoke. Chimneys of this sort are to this hour common in Scotland; especially in the kitchens of farm-houses, which are almost invariably of this construction.

But as luxury encreased, and the elegant arts became more common, these fire places were contracted to a narrower size.—The grate, instead of being placed in the middle of a large area, with seats around it, was pushed close to the back wall. The width of the opening of the vent, was found to be sufficient if it contained the whole of the grate;—and as the fire warmed the room more effectually when it came well forward, the grate was brought as far into the apartment as could be done. — The pipe of the chimney was contracted to such dimensions as to admit of being contained within the thickness of an ordinary wall, and reduced to that elegant and commodious tube now known by the name of *chimney*.

As this form of a chimney is the most elegant, most commodious, and most efficacious for carrying
ing

ing off the smoke from our apartments, I confine myself here to point out the defects of these chimneys, and the most effectual means of removing or preventing smoke.

To explain these circumstances more clearly, — let us suppose that A. B (Fig. 1.) represents the tube of a chimney, in the bottom of which at A a fire is lighted. From the principles already explained, it is obvious, that, in this situation, the air which is heated by the fire at A, will ascend directly towards B, without mixing at all with the cold external air, till it arrives at the top of the chimney, after which it will be dispersed in the external atmosphere; — and as the more weighty air that presses in to supply its place, can get no access into the funnel but at the opening between A and E, it presses back the flame and smoke arising from the burning fuel towards the back of the chimney; — and being itself heated as it passes immediately over the fire, it ascends up the chimney in its turn, thereby occasioning a constant stream of air from the fire-place to the top of the tube, which hurries the smoke along with it, and prevents the smoke from being felt in our chambers, so long as that regular current of air is not interrupted.

This is the manner in which fuliginous vapours are made to ascend in our chimneys; by carefully attending to which, it will be found, that the following useful corollaries may be drawn, with regard

gard to the construction of this useful part of our habitation.

1. The higher the chimney is, or, in other words, the greater the distance between the fireplace A, and the top of it B shall be, the greater will be the difference between the weight of the column of heated air in the tube, and another column of air in the common state of the atmosphere of the same diameter without the chimney; and consequently the air will enter with the greater force at the opening A E, and carry up the smoke with the greater rapidity along with it: for as the warm air within the tube continues rarefied in a high degree, till it issues from the top of the chimney; and as it is in every part of its length lighter than the same bulk of external air, marked by the dotted line C D; it follows, that the longer these two columns of unequal gravity are, the greater must be their difference of weight; and of consequence the pressure of the most weighty, at the only opening, into the lighter, will be the greater.—Hence it is that high chimneys (*ceteris paribus*) have a greater suction of air, and are less liable to vent ill, than low ones; and this is one principal reason why in the same house the chimneys in the garrets, and the higher stories, are more apt to vent ill, than those on the floor, where the chimneys are of necessity longer.

A smoky chimney, therefore, may sometimes be cured, merely by raising it higher than formerly.

It likewise follows, by the rule of contraries, that if an opening be made into the chimney, as at F, the air will enter with less force at E, and carry up the smoke with less velocity than before, and thus be in danger of occasioning smoke in the apartment from which it leads; for this opening, as it admits the fresh air into the tube, has nearly the same effect as shortening it so much would have had.

Hence likewise we may see the reason why a chimney ought in general to vent better, and make the fire burn more briskly, in very cold weather, or in extreme cold climates, than in such as are warmer: for as the air that passes over the fire into the tube, will in these cases be heated nearly to an equal degree, the column of air within the funnel will be nearly of equal weight in both of these cases; — but as the density of the external air is greater in cold than in warm weather, the difference between the weight of the two columns upon the whole will be, in cold weather, more considerable, and consequently the suction be more violent*.

2. As

* Should it be objected to this reasoning, that the barometer shews that the weight of the atmosphere is upon the whole as great in summer as in winter, and that therefore this reasoning cannot be just, I answer, it is very true that the weight of the whole body of the atmosphere may be of equal

2. As the smoke is forced up the chimney merely by the rarefaction of the air in consequence of heat, it is evident that the more the air is heated, with the greater force (*ceteris paribus*) will it ascend; because the difference between the weight of the external and internal air will be greater: and as the air will be the more heated the nearer it is made to pass by the fire in its entry into the chimney, it is evident, that the smaller the opening at A E is, or, in other words the lower the mantle of the chimney is, the air will be forced to pass the nearer the fire; and therefore be more rarefied, and ascend with the greater velocity: so that lowering the mantle of the chimney will often cure smoke.

But as it is frequently inconvenient to have the mantle of the chimney too low, the same effect may be often produced by other means. — For as the fire place is usually made wider than the length of the grate, a good deal of cool air is allowed to pass at the two ends of the grate, without being much heated; which greatly diminishes the suction of the chimney. This inconvenience may be easily removed, by closing the vacancies at each end of the grate, so as to allow no air to enter from below,

equal weight at these two different seasons; but as the air in cold weather is so very much condensed the same weight cannot reach nearly to the same height at different seasons; so that the weight of two given columns, of equal altitude, must at these seasons be extremely dissimilar.

except

14 ON SMOKY CHIMNEYS.

except what comes immediately through or passes before, or above the fire. For this purpose, grates consisting of a neat hewed stone at each end, with a breast and bottom of iron fitted to them, as represented at Fig. 2. are extremely convenient.

It sometimes also happens, that the aperture of the chimney is not suddenly contracted immediately above the mantle, but goes on tapering slowly, as in the same Fig. 2. in consequence of which form of construction a quantity of cool air is allowed to enter at the two corners of the mantle, without coming near the fire. The most easy and effectual method of remedying this defect, is to place a sheet of milled iron within the mantle on each side, as low down as possible, making them slant a little upwards towards the middle of the chimney; as at A, Fig. 2. the mantle being represented by the dotted line. By this contrivance, the air, which enters at the side of the mantle, before it can ascend into the chimney, is forced to pass very near the fire, and of course is much rarefied. The good effects of this would be still more strongly felt, if one of these plates were placed a little lower than the other, and made so long that the ends should cross each other, as at A B, Fig. 2. by which means every particle of air that went up the chimney, would be forced to pass immediately above the fire. It is almost unnecessary to observe, that these plates ought to be so contrived, as to admit of being taken out at pleasure to allow the chimney to be cleaned.

A chimney.

A chimney may not only be defective by having the mantle too high, or by being too wide from side to side, but also by being too deep between the fore-side and the back, as is often the case in very old houses. In this case, the distance between the fire and the mantle is so great, that much air passes up without being sufficiently rarefied, as in the chimney represented at Fig. 3. This fault may be sometimes cured, by bringing the grate a little forward, which, by making the fire act more powerfully upon the mantle, rarefies the air more in its passage.

But although this may be of service in some cases, yet its effects are for the most part inconsiderable : and on some occasions it even does harm. For when the grate is brought forward, there is a great vacancy left between it and the back of the chimney, so that the air passes under the grate, and ascends behind it very little rarefied ; so that if the feet of the grate be not very low, there will be as much lost in this way as will be gained in the other : and as there is not enough of heated air in the chimneys of this kind to make the vapour ascend with rapidity, they are often choaked with thick fuliginous vapours hanging in them, almost *in equilibrio* with the rest of the atmosphere, so that the least puff of wind beats them down the chimney, and pushes the smoke into the room ; whereas, when it is far back, it is driven down upon the hearth, and rises upwards again when the gust is over, and a great deal of it is
 caught

16 ON SMOKY CHIMNEYS.

caught within the mantle as it rises, which in the other case would have been dispersed through the room.

When this is the case, the most effectual method of cure is, to bring the grate forward till the forepart of it is immediately under the inner edge of the mantle; then build up the vacancy at the back of it, the whole width of the fire-place from side to side, raising it perpendicularly till it is as high as the back of the grate, and then bending it forward towards the mantle, as is represented at fig. 4. When it is as high as the workman can reach, let it be suddenly turned backward again, sloping a little upward, as in the figure; then fit a sheet of milled iron to the inside of the mantle, making it slant a little upward toward the back part, at a small distance above the new-erected masonry, and extending within a few inches of the back wall, as at A, Fig. 4. By this construction all the air that enters into the chimney is made to pass immediately above the fire, between it and the heated iron, upon which the flame acts with the greater force, as the back of the fire-place is bent a little forward above the grate, and the heat is likewise reflected into the room with the greater force: at the same time, if the smoke is accidentally beat down the chimney by a sudden gust of wind, it will be caught by the sheet of Iron, and prevented from coming into the room. If the fire-place be very wide between the one side and the other, the new masonry may be carried

ried quite up to the sheet of iron on each of the sides.

3. As every fire requires a constant succession of fresh air, the tube for conveying this rarefied air to the higher regions of the atmosphere must be of a sufficient size to contain the whole of it, and allow it a ready passage; otherwise a part of it will be forced to seek some other passage; and will thus naturally diffuse itself into the apartment in which the fire is placed. Every chimney therefore ought to have a degree of wideness sufficient to carry off the whole of the smoke arising from the fire usually burnt in it, otherwise the apartment will be almost continually filled with smoke. —

This is a fault more common at present than any of those already mentioned, especially in large towns, where the number of chimneys in one wall is often so great, that it is difficult to get a sufficient space for each.

The most obvious cure, where the situation admits of it, is to widen the chimney, by opening a hole a little above the grate through the back wall of the chimney, slanting a little upward, and building on the outside of the wall a small chimney open from that hole to the top of the building, as in Fig. 5. where A B represents the new tube going through the wall at the opening at A, which will receive the superfluous smoke, and carry it off. This additional chimney must always be carried as high as the other. But as there are many situ-

ations in which this method of cure would be impracticable, we must try every method for accelerating the ascent of the smoke ; (for the more quickly it ascends, the more narrow may the tube be), and with that view the chimney may be heightened at top, and contracted at bottom, in any or all the various ways we have mentioned. But if none of these methods prove effectual, let the chimney be built quite close at the under part, leaving only as much room as is sufficient to contain the grate, having a cover of metal fitted to that opening, which can be taken off or put on at pleasure ; by which the whole air that enters into the chimney is made to pass through the fire like a furnace, and carries the smoke up it with great velocity. These are well known in large towns by the name *smoke-chimneys* : but as they occasion a prodigious waste of fuel, without warming the room ; and, unless they be attended with very great care, are in danger of setting the building on fire, they ought to be as much avoided as possible. But if neither this, nor any of the other methods prove effectual, the wall must either be taken down, and rebuilt in a proper manner, or the chimney abandoned as incurable.

As this is a defect more difficult to be remedied than any other, we would strongly recommend it to every builder to make his chimneys at first of a sufficient width throughout. There is no danger

danger of erring on this extreme, as it is easy to remedy any defect that may arise from it.

4. As the air which ascends through the chimney continues nearly of an equal degree of heat to the top, the tube should be of an equal degree of width at the top as at the bottom, as well as through the whole of its length. It ought not therefore to be made tapering gradually from the fire-place to the top, but to be suddenly contracted above the grate, as in Fig. 6. from which it ought to be continued of an equal wideness throughout its whole length: but if it is narrower at any one place than another, it ought to be at the under part, immediately above the fire, for a very short space; because, as this is within reach of the hand, the soot can be cleaned from it as often as is necessary; so that when the other parts of the chimney are full, and clogged with soot, they will not be narrower than this place is at that time.

5. It seldom happens that a chimney can be carried quite straight upwards: and it is an advantage that it is so, as they ought always to be bent a little: for if a chimney be straight, and of a proper width to transmit the whole of the smoke and no more, it will not be sufficient for that purpose, when there is a heavy fall of rain, or snow, or hail, with little wind; for the great drops will fall perpendicularly from the top to the bottom

of the chimney ; and as they occupy a considerable space, the smoke will not have room to ascend, but must be forced down with the shower, and dispersed in the apartment ; whereas, if the chimney is bent, the rain falls upon some of the sides, and glides gently down without disturbing the ascent of the smoke.

The same inconvenience will be felt in a straight chimney, where it is so placed as to be exposed to winds, which sometimes enter the top, and blow down with a sudden puff ; for if it be straight, the air meets with no interruption till it descends into the chamber, and there disperses the smoke ; but if it be crooked, the descent of the wind will be obstructed,—its force broken, and the bad effects of it in a great measure prevented. Upon the whole, bent chimneys are always preferable to straight ones. However, a perpendicular chimney may be easily cured by some of the contrivances after mentioned.

These are the most general defects arising from the structure of the chimney itself, which are all reducible to the following causes : 1. Too little height ; 2. Too great wideness of the bottom of the chimney ; 3. Too little width ; 4. Unequal wideness between the top and bottom ; and, 5. Straightness of the tube. The best methods of curing each of these defects have been already pointed out. And I shall conclude these remarks on this general head, by the following plain directions

rections to operative masons, founded on the preceding observations.

Plain directions to operative masons how to construct a chimney, so as most effectually to carry off the smoke.

1. **O**BERVE to contract the chimney at each side till it comes to its proper width at as small a distance as possible above the fire, as is represented in Fig. 6. in which A B C D represents the front-view of a modern fire-place, with the mantle cut off, to discover the manner in which it is contracted at the sides. The dotted line shows the depth of the under lip of the mantle.

By contracting the sides thus suddenly, all the air that enters into the tube is forced to pass immediately above the fire, so as to be unavoidably heated in its entry.

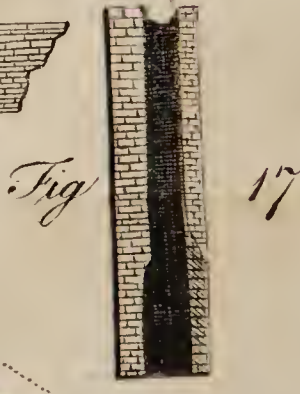
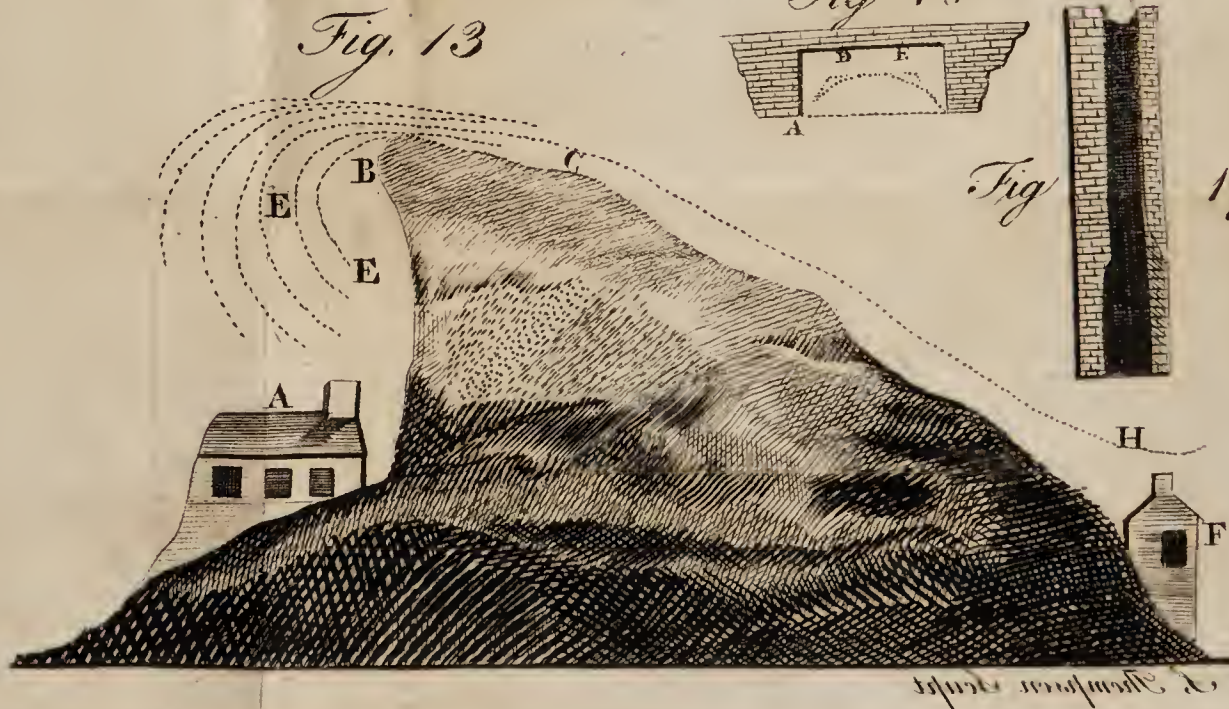
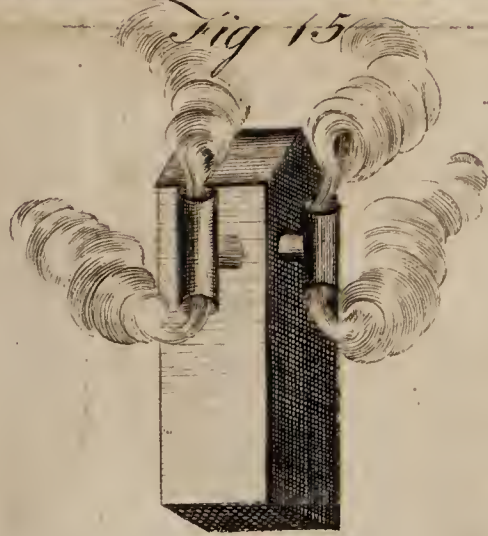
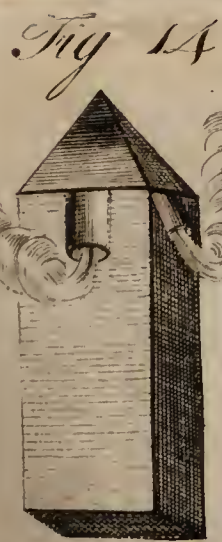
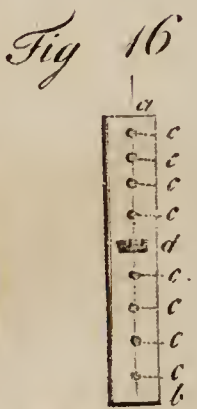
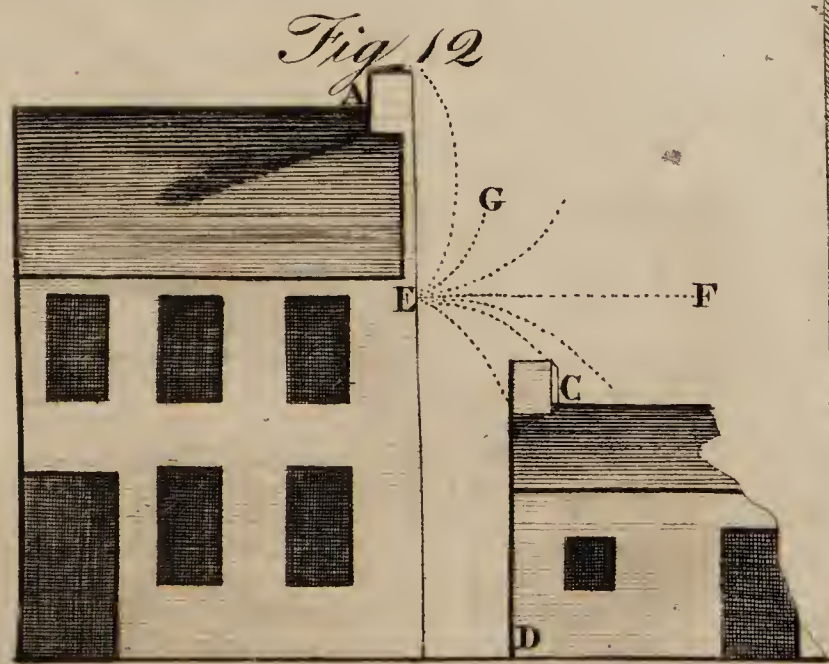
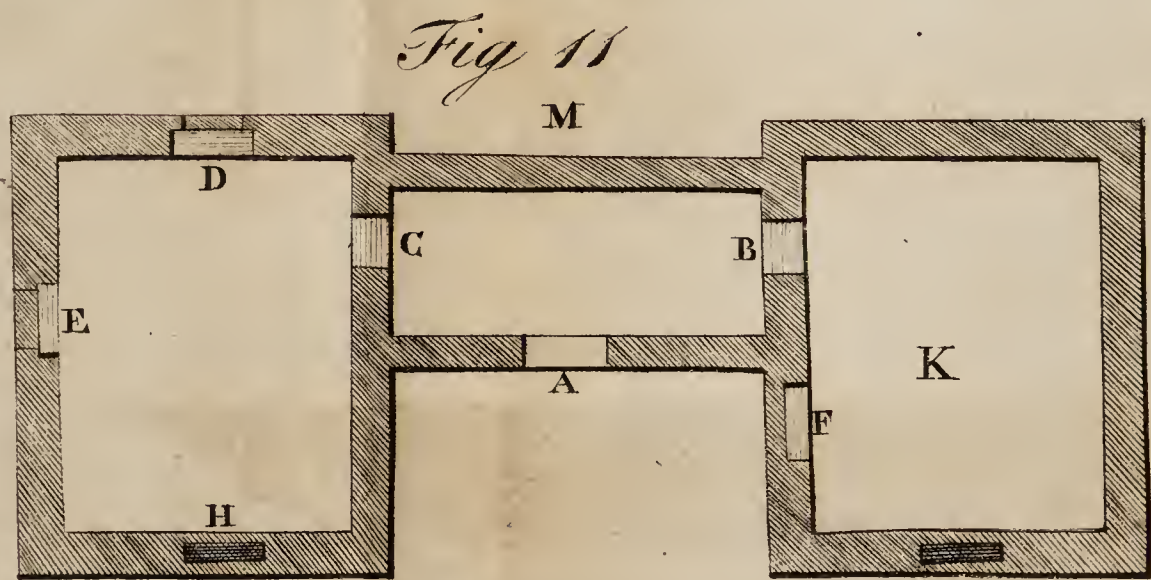
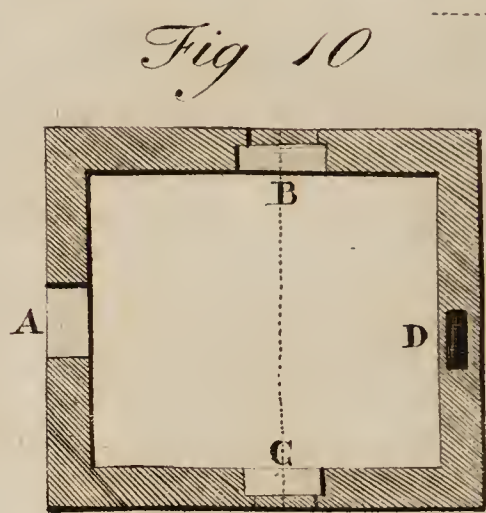
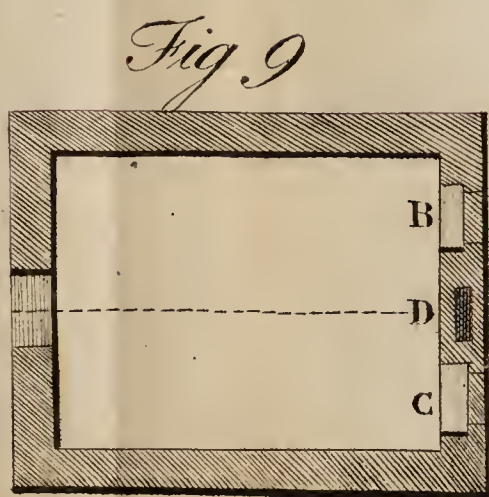
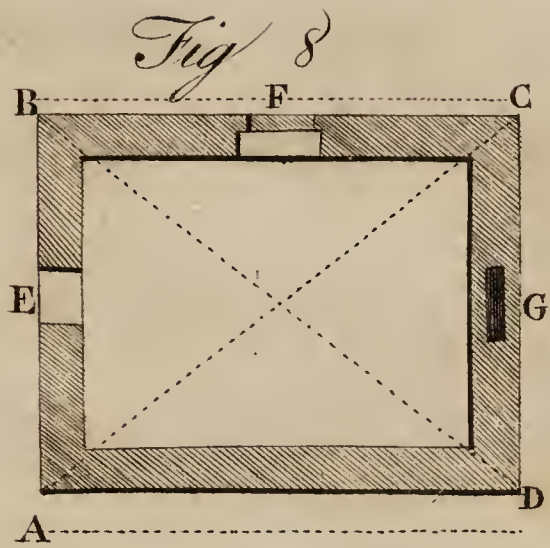
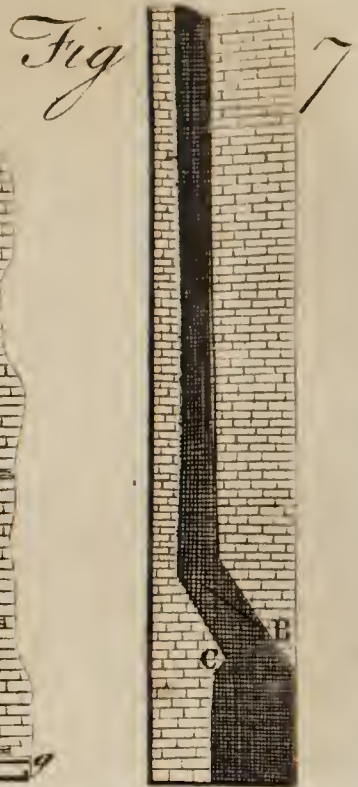
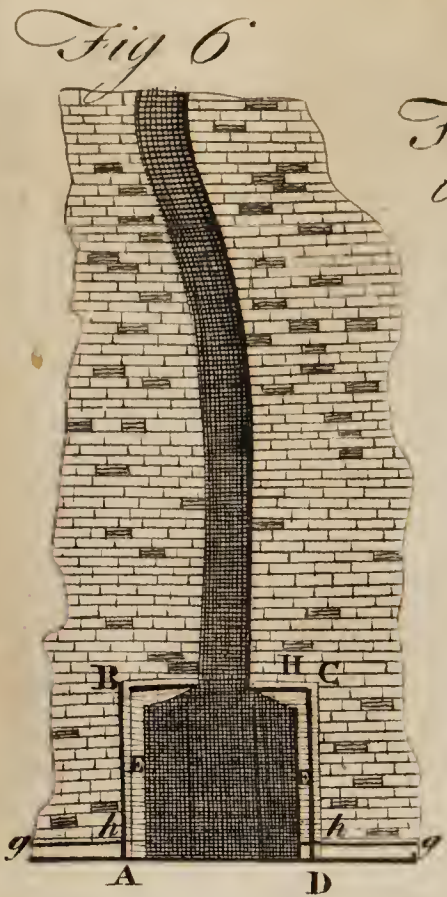
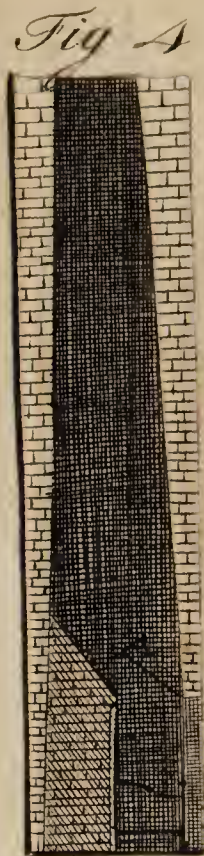
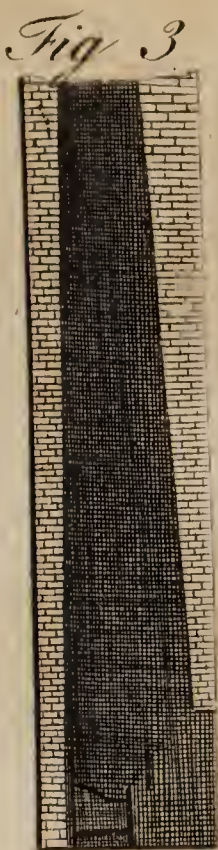
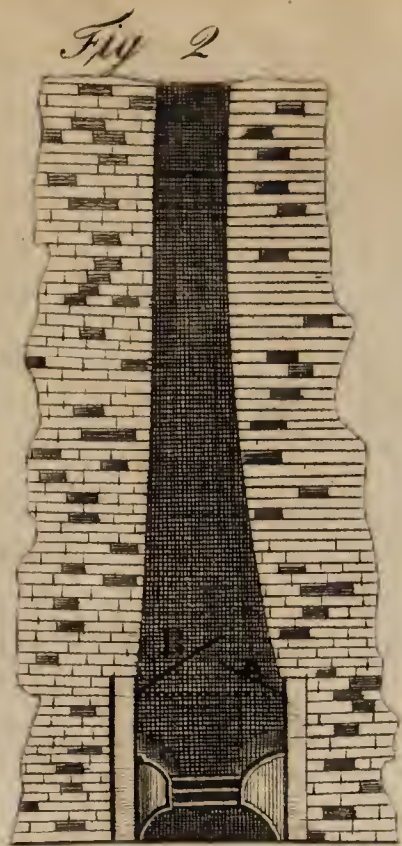
By this form likewise the smoke is carried directly upwards, without being allowed to spread itself to either side, so as to füll the back of the fire-place to a great breadth on either side, which is an inelegant and disagreeable blemish.

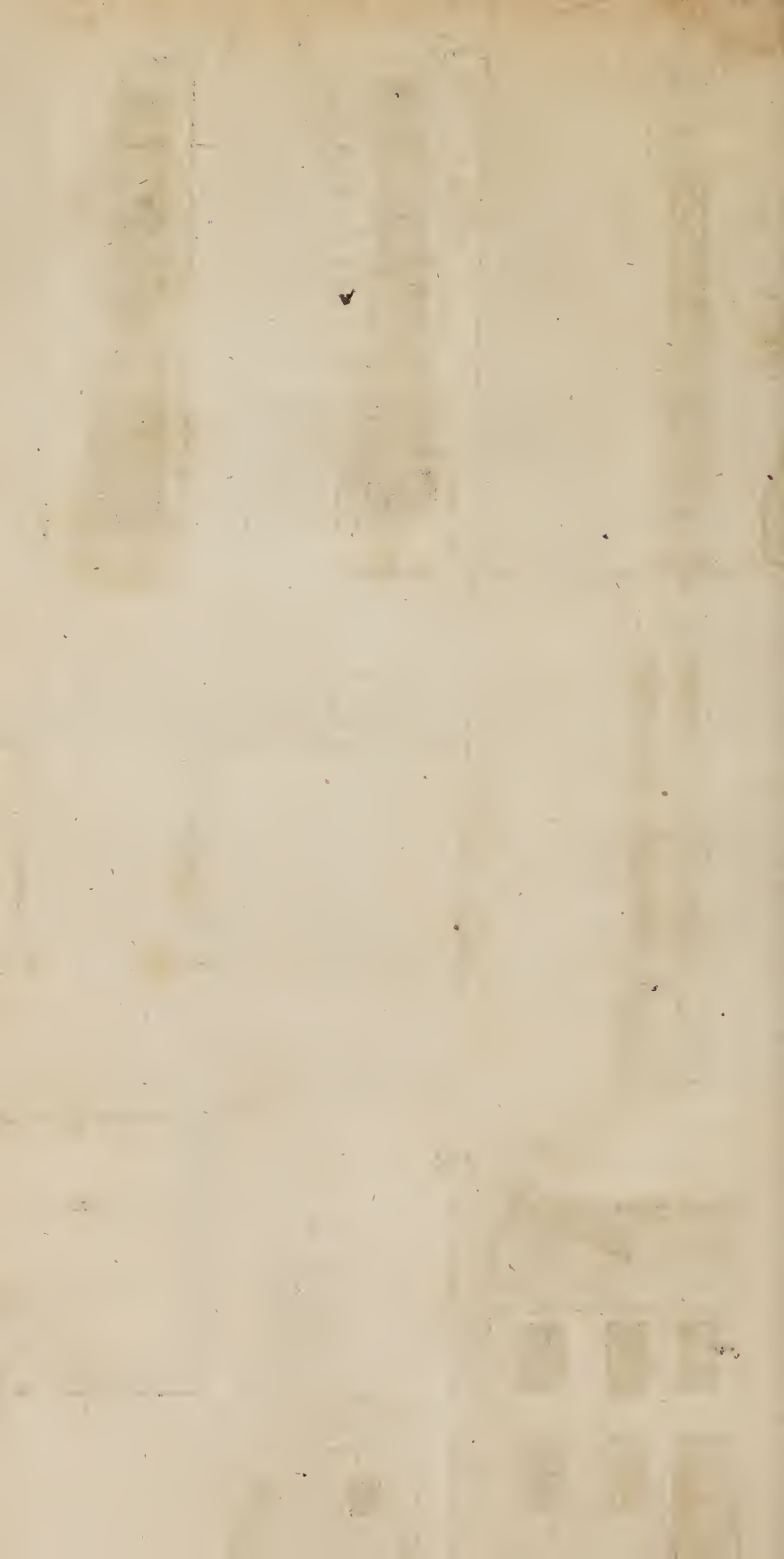
2. When

2. When the tube is thus contracted to its proper size, let it be carried upwards from that to the very top at the same degree of width throughout the whole, with as little variation as possible: for if it is narrower at any one place than another, it will be impossible ever to get it properly cleaned; and nothing is so apt to retard the ascent of smoke as lumps of soot adhering to the sides of the chimney;—not to mention the disagreeableness, of having soot frequently falling into the grate, and the danger of setting the chimney on fire, which must ever be a consequence of a neglect to this precaution.

To be certain of keeping the aperture of an equal size in every part, provide a board of the breadth and width of the funnel, with any sort of a handle fitted to it, which may always be employed as a gauge for ascertaining with precision the proper size of the tube. Be particularly careful to try it frequently in those places where the tube is bent, as it is in these that there is the greatest danger of erring; and on all these occasions let one end of the board be made to rest on the *convex* side of the funnel; and, keeping that firm on a point, move the opposite end a little upwards and downwards, so as to make it describe a small segment of a circle; and if it has always freedom just to move in that way, you cannot possibly be in danger of erring.

Many





Many will despise this assistance, as troublesome and unnecessary, and trust to their eye, which they think sufficiently accurate: but I would advise a man who builds a house for his own accommodation, to see that this precaution be not neglected; as many of the faults of modern chimneys are occasioned by a want of attention to this circumstance;—which is attended with the more disagreeable consequences, that it is a fault which cannot afterwards be remedied without pulling down the chimney entirely.

3. Although it is no inconvenience to the chimney to be bent in any direction, yet these bends ought to be made as gradually and easily as possible.—Avoid, therefore, sudden bends as much as may be; for if these are very acute, they retard the descent of the things that are employed in cleaning them; and if any kind of weight is made use of to sink the ropes employed for that purpose, in places where chimneys are not usually cleaned by boys, the plaister is apt to be hurt by their lighting violently upon it, and the chimney much damaged by it.

4. It has been hitherto the general practice, to make the aperture of every vent-hole a square or oblong,—a four-sided figure of some sort;—which is on every account an improper form: for where chimneys are cleaned by a bundle of twigs drawn through them, (the only way which a civilized nation ought to admit of), the twigs cannot be pressed

pressed into the corners;—so that the soot must remain there in spite of the utmost efforts of man to take it away: which is not only disagreeable, on account of its falling frequently into the apartment, but dangerous also for catching fire;—and is besides of no utility in helping to widen the vent;—for these rough corners, filled with nobs of soot, retard the ascent of smoke, as much, or more, than if they had been filled quite up with solid masonry, and smoothly plaistered, so as to admit of being kept perfectly clean without trouble.

On these accounts let the vent-hole be always of a curved form,—either entirely round, or oval, with any degree of flatness that suits the form of the wall, and other circumstances. This would not only prevent the inconveniencies above enumerated, but would also tend much to strengthen the wall; an object well worthy of attention where many chimneys are to be carried up.

In places where bricks are common, it would be no difficult matter to have these so framed as to suit the form of vents of any dimensions, or any species of curvature, which would greatly facilitate the making them. Where stone is necessarily employed, it would be a little more troublesome.

A mould in this case would be rather more necessary than in the present form, and therefore ought on no account to be neglected.

5. Be careful that the inside of the chimney be plaistered as smooth as possible throughout its whole length; because the smoothness of the internal surface of the vent, greatly promotes the ascent of the smoke, and prevents the adhesion of the soot to the sides, and the unnecessary accumulation of too much of it within the chimney.

This may perhaps appear a superfluous advice, as the practice is almost universally allowed to be necessary.—But it is in general performed in such a slovenly manner, as hardly to answer the intention in any degree; and the masons are for the most part so inattentive to prevent lumps of the plaister from falling off their trowels in the operation, that much of it falls down, which lighting upon the bended part of the vent, is there allowed to harden into lumps,—choke up the passage in a great measure, and produce other disagreeable effects that ought to be carefully guarded against.

On these accounts let the mason be careful at all times to have a sufficient quantity of the finest hard plaister, prepared in the most perfect manner, ready at his hand for plaistering the inside of his vents as he advances.—Let him always lay on the plaister before the chimney is advanced so far as to prevent his reaching down it with ease;—and to prevent any loose bits from falling down, let him have a small piece of board to hold in his left hand, so formed as to apply close to the curvature of the chimney, which he ought to hold
beneath

beneath the trowel when he is applying the plaister.

—After it is applied, and smoothed as well as can be done while yet soft, allow it to harden a little, and then smooth it better with the trowel.

—After it has been allowed to harden a little longer, return again to smooth it still better;—and, wetting the back of the trowel a little, work it strongly; and in a short time it will assume a hardness and polish little inferior to marble.

This is the best method of finishing the inside of a chimney;—and the additional expence between doing it thus or in the ordinary way, is but a trifle.

6. As it is an advantage on all occasions to bring the grate as far forward into the apartment as possible, the mason ought to take care in time to provide for this, by cutting the under edge of the mantle as thin as the nature of the materials of which it is made, will admit of,—sloping it upwards within, so as to admit of such a thickness at the upper edge as to allow it to be of a sufficient degree of strength to support itself, and what else it may have occasion to bear, as is represented at B, Fig 7. for if the under edge of the mantle be as thick as usual, such as is represented in Fig. 3. and 4. there is a necessity of placing the grate as far back as to be within the inner lip of the mantle; otherwise it interrupts the smoke in its ascent, and throws it out into the apartment:—but if it be tapered to a thin edge, the grate may be brought

brought forward almost to a level with the fore part of the mantle.

7. For promoting the same design, where the thickness of the wall is sufficient to admit of it, let the wall at the back of the fire-place be built so thick as to allow no more than sufficient room for the depth of the grate, as is represented in Fig. 7.; and in order still more powerfully to throw the heat outward into the apartment, let the wall at the back of the fire-place, above the grate, be bent a little forward, as at C, Fig. 7. which will not only help to effectuate that, but also to make the smoke ascend more freely.

Where the wall is thick, it may be turned backwards, as in the same Fig. 7. immediately above the curvature;—but where there is not room for that, it may be carried up perpendicularly from the fire-place, as in Fig. 17. without any sort of inconvenience.

8. Be careful in all cases to allow of a sufficient degree of width to the chimney throughout the whole length, for the reasons already assigned;—and that you may be allowed to bring the grate far enough forward, and at the same time allow of a proper size for the funnel, and preserve its proper form from top to bottom, in all cases where large fires may be used, it will be most adviseable to make the aperture of the form of a flattened oval, which

which will admit of an opening of a sufficient size even in a thin wall.

9. Although it is necessary to have all chimneys pretty wide ; yet this, on many occasions, is attended with inconveniencies : for as they transmit a great quantity of heated air, too large a portion of that warm air which ought to heat the chamber, is carried off ; and as it is only when the fire is first kindled that the great quantity of gross vapour is exhaled which fills the chimney, and makes a large tube necessary, if it were so contrived as to contract or dilate at pleasure, we might have our chimney of a sufficient width to convey away the greatest quantity of smoke that could ever have occasion to pass through it, while we would have it in our power never to allow more air to pass off at other times than was necessary to carry away the whole of the smoke, by which means a much smaller quantity of fuel would keep our apartment equally warm.

This, it is apprehended, might be accomplished by the following simple apparatus. Let a sheet of milled iron be fixed at the upper part of the mantle, on the inside, at B, in such a manner, as that, by means of a small wire *d e*, passing through a small hole left for that purpose in the inside of the chimney, as shall be by and by explained, it might be let down at pleasure towards C, or drawn up towards B, so as to apply quite close to the upper edge of the chimney between B and C.

This

This would leave the tube of its full wideness when necessary, or close it to any degree at pleasure, with the greatest ease.

If it should be thought proper to adopt this contrivance, it would be necessary to carry up the inside of the forepart of the vent flat instead of curved, from B, till it came as high as the top of the iron plate, so as to allow it to apply close to the wall when pulled back. The curvature on the back of the vent should be continued till it reached the fire-place.

But it would be still a more important improvement, if instead of having only one plate, there should be two, as represented Fig. 17. One of these, E, Fig. 17. needs to have no liberty of moving backwards or forwards, but barely admit of being taken off or put on at pleasure, so as to allow the chimney to be cleaned when necessary, &c. The other plate F, should admit of being raised or depressed at pleasure, being moved upwards or downwards, by a wire fixed near the point of the plate, and passing through a hole made in a small piece of iron placed in the wall for that purpose when building. From that hole the wire might be brought to one side of the grate to the slope at the side within the mantle, as at H, Fig.

H, Fig. 6. where it is joined to a handle * Fig 16. that might be moved so as to raise and depress it at pleasure, without being the smallest blemish to the fire-place, as it would be entirely concealed.

By this contrivance, when the plate F is drawn close to the wall, there will be as much room for a free passage to the smoke at the top of the plate

* The wire might be fixed to a small brass handle, moving freely upward and downward, like that for a bell : only this should have a long slit in the middle of it, with notches on each side, to receive a pin placed in the middle of the slit, by means of which the wire might be lengthened or shortened at pleasure. The whole of this apparatus is represented at Fig 16. where *a* represents the wire fastened to the brass plate ; *b* a piece of brass, raised a little, to serve as a handle. The slit in the middle is represented by the dark line, having notches *c c c* at convenient distances. The pin *d* is fixed into the wall, but left at liberty to turn about with ease ; and its head stands up a little, so as to be easily turned with the finger and thumb. The body of this nail is made so thin in one direction, that when it is turned half round, it easily passes through the slit in the plate : but in the other direction its diameter is greater ; so that when the plate is brought so as to have one of the notches opposite to the nail, and it is then turned half round, it catches the plate so that it cannot be moved till the nail is again turned about.

E, as

E, as in any other part of the chimney :—for although the tube seems to be contracted at that place by the projection of the plate E so far forward ;—yet, on account of the flatness of the side of the vent at the place where the plate F applies to it, instead of the curved form of the rest, the vacant space will be there as great, or nearly so, as in any other part of the tube ;—and when it is convenient to diminish the size of the tube, by lowering the plate F, it may be brought as near the plate E as shall be convenient, and may even be made to touch it, if that should be thought proper.

It is hardly possible to think of a more perfect manner of constructing the neck of a chimney than this would be.—For as the whole force of the fire is necessarily brought to act principally upon the two iron plates where they cross one another, and as no air can enter into the chimney without going through that passage, it must be strongly heated, and of consequence must rush through the tube quickly, till it reaches the top, and thus occasion a constant suction of air in that direction ;—the only mean of carrying off the smoke with certainty.—It would likewise be attended with another advantage, that of preventing the possibility of soot, or any other dirtiness, that might come down the chimney, from falling into the fire, or spreading through the room, as it would be intercepted by, and lie on the back of one or other of the plates till taken away.—It
is

is with a view to get them easily clear from this, as well as to admit of getting the chimney cleaned, that they should be so formed as to be taken out at pleasure.—And although I have always mentioned the place where the under part of the moveable plate F joins to the wall as a hinge, yet it is plain that nothing more is necessary for retaining it in its place, and admitting of the necessary movements, but two supporters, like those usually employed to support a mirror;—nor ought any more complex apparatus be adopted.

It is likewise plain, that if these plates are carefully formed, so as to apply exactly to the sides of the chimney all round, and to one another, when the moveable plate is let down, so as to touch the other, it would answer every purpose of the most perfect kind of smoke-board, which could be taken off or put on, with infinitely more ease than any other sort whatever.

It is sufficiently plain, that the plate at A, Fig. 4. and those at A and B, Fig. 2. might be so contrived as to answer in some measure the same purposes.

These are all the circumstances necessary to be attended to by the mason in constructing a chimney, so as to carry off the smoke properly.—And I might here finish my directions on this head;—but as the proper form of the fire-place is so nearly connected with this, I hope a few words on
that

that subject will not be considered as intolerably superfluous.

In houses that are built with a view to be let, it is always proper to make the fire-place large; the sides of which should be carried back almost at right angles from the wall, or with very little slope; for as the tenants who may wish to occupy the house, are often possessed of grates of a particular form, if the fire-place is not sufficiently large to admit them, it is a sufficient reason to make them reject that house, and chuse another.

But unless it be for this, or some similar reason, that form of a fire-place ought never be adopted, as it is the most disagreeable and inconvenient that could be made choice of.

A fire is not only of use to produce warmth, but as it is of itself such an agreeable and chearful object, it attracts a more than ordinary share of our attention, and therefore the place allotted for it, requires to be finished off with beauty and elegance.—An apartment never yet was chearful and pleasing where the fire-place was large and unfinished:—like an eye deeply sunk in the head, it occasions a gloom, that the most chearful features in other respects are not sufficient to efface. Much attention, therefore is necessary to give them their proper form and symmetry.

It is on this account I have been at pains to point out the circumstances necessary to admit of

bringing the grate sufficiently forward :—and that the fire may produce its fullest effect, not only in warming, but also enlivening our apartments, it is always proper to make the sides of the fire-place slope inwards, with a very obtuse angle from the wall, so as that if it be made angular, the flat part at the back of the grate should be as small as may conveniently be admitted.

But perhaps the most elegant as well as the most proper form for reflecting the heat outward, is that of the segment of a large circle, or rather ellipsis, which if lined with Dutch tiles painted white, or with light and cheerful colours, and elegantly designed, is the most agreeable mode of finishing for that part of our chambers that has been yet adopted.—The joinings of these are a blemish ;—perhaps improvements might be made in this respect :—but all that has any relation to the mason's business is the *form*.—It was only to instruct him as to this particular that I digressed so far :—It would be too much to transgress farther.—I now return ; and shall proceed, in the following section, to consider those cases that belong to the second general cause of producing smoke.

To assist the reader to form a proper idea of what is intended, I have given the plan of a fire-place, Fig. 18. in which A B is the mantle, represented by a dotted line ;—the area A B C D represents the space left vacant in the wall for the fire-place in the ordinary form of a house *to be let* ;—
the

the elliptical line A E B represents what I think the best form of the inside of a fire-place;—and the lines A F G B is what I would recommend instead of it to, such as prefer straight lines to a curve.

S E C T I O N II.

Of Smoky Houses occasioned by faults in other parts of the building, altogether independent of the structure of the chimney itself.

I. **T**HE first defect I shall take notice of, is too great closeness of the room, Smoke, as shewn above, is impelled up the chimney by the pressure of the air entering at the fire-place, and rising upwards after being rarefied by the heat of the fire; but if fresh air is not admitted into the apartment in sufficient quantities, to supply the consumption by the fire, the room will be quickly exhausted, and the air in it become as light as the external air at the top of the chimney, so that the smoke will as readily be dispersed into the chamber as through the chimney.

In this case, if any door or window is opened, so as to admit plenty of free air, the smoke will be quickly dispelled, and the proper circulation established. The same effect will be produced, by making a small hole in some of the sides of the room: but unless this be done with some judgment, it may frequently add to the disease, as it

may concur with some of the other causes of smoky houses, to be afterwards mentioned.

A better method of remedying this evil would be, to have a small hole made in the wall at the back of the chimney, and immediately underneath it: or a small perforation made in the wall in any other convenient manner; the one end of which should communicate with the external air, and the other communicate with the chamber in any place near the grate, and as low down as possible, through which a constant supply of air would be administered to the fire, without the smallest inconvenience or trouble.

If this were practised, doors and windows might with safety be made much closer than usual, and our apartments rendered equally warm and comfortable, with a much smaller quantity of fuel than we use at present. For as the fire, in the ordinary mode of constructing chambers, is kept alive by a constant succession of cold air from the doors, windows, and other crannies of the room, rushing towards the chimney in all directions, the air of the room, which, if not cooled by this means, would be quickly heated to a great degree, is constantly kept cold, in spite of the strong heat of a blazing fire; which at the same time that it scorches the parts of our body that are most exposed to it, does not warm the parts which are turned from it; and we experience at the same time a burning heat and piercing cold, which is often productive of the most disagreeable effects.

But

But if the fire were supplied with air in the manner above mentioned, there would be less air drawn in through the crannies of the room, so that what was within would be soon warmed, and continue long so, even with a small degree of heat.

However improper this might be for people in perfect health, it might surely be of great use for those who are in a weakly habit of body; especially if care were taken to carry off the foul air, by having a small tube leading from the upper part of the room to the top of the house, through which the air than had been rendered noxious by the smoke of candles, or perspiration would be conveyed away, and a succession of fresh air admitted from the tube near the fire-place to supply that want.

That the reader may more readily comprehend what is here meant, I have represented in Fig. 6. a view of two small tubes for this purpose, supposed to be laid open by taking away the boxing or inner coating of the wall which ought to cover them. These are of wood, and need not be above one inch in diameter. One end, *g g*, goes quite through the outer wall of the house, and communicates with the open air, having a small grate upon it to prevent vermin from entering. The other end, *b b*, passes behind the two slabs at the side of the fire-place, and opens in the inside of the fire-place, at *ii*; at which place they have each of them a small bit of brass fitted to them, being closed with two sliding doors exactly like

like those that are used to cover the end of telescopes, by means of which more or less air may be admitted at pleasure.

If any one should think of adopting this species of refinement, it is proper he should be warned of the inconveniencies that may attend it, as well as the benefits that may result from it. I shall therefore be excused for pointing these out on this occasion with some degree of precision.

Perhaps nothing contributes so much towards preserving the health of sedentary and recluse persons, as the fires that are usually burnt in our apartments; as they perform the part of a perpetual ventilator, which helps to carry off the foul air, that is continually generating by the breath of the company, and burning of the candles; which would soon be accumulated in such quantities as to become extremely noxious, were it not for the aid that this affords us in cold climates.—— On this account open fires, which are much more chearful, are also more conducive to health, than concealed stoves, which are employed in some cold countries.—— We ought therefore to adhere to our own old fashion, and not be in too much haste to imitate our frugal neighbours in this particular.

For the same reason I would by no means advise, that the method above described of feeding the fire with fresh air, should be adopted without proper precautions. For should our doors and windows be made very close, and these pipes for admitting

mitting air be left open, the fresh air would be so readily admitted by that means, as to keep the air of the room in *æquilibrio* with the external atmosphere, so that little or none would be pressed in through the crannies at which it at present enters; and the perpetual ventilation would thus be stopped,—and the foul air be continually retained in the room;—which might thus indeed be heated at a much smaller expence, and more equally, than at present, but it would be at the same time less healthful to the inhabitants.

It would, therefore, by no means be safe to introduce the cool air by this contrivance, without at the same time opening a vent-hole in the top of the room, by which the foul air might be carried out of the apartment. This might be done by means of a small tube opening into the room, either in or near the ceiling; which might either be carried to the top of the building, or be made to communicate with the external air by a small perforation through the wall at the roof of the room, by means of either of which a proper circulation would be established, and the foul air be carried off.

For the fire would no sooner have warmed any particles of air within the room, than these would be greatly expanded, and rise immediately upwards, so as to fill the higher parts of the room with rarefied air;—and as other particles would be successively heated and rarefied in their turn, by their expansive force they would press upon

the sides of the apartment in every place, so as to force the lightest particles through the opening left for that purpose in the top of the room, by which means the foulest air would be gradually drawn off, without descending again into the lower regions, to the annoyance of the company.

By attending to these circumstances, it will appear sufficiently obvious, that a room which has such a ventilator within itself in the roof, will be more sweet and wholesome than one in the ordinary fashion.—For although the fire ventilates the under part of the room well enough; yet such particles of air as are rarefied by its action at such a distance from it, as to be buoyed upwards beyond the reach of the chimney, when they once rise above the top of the mantle will be carried directly to the top of the room, where they must remain clogged with the foul vapours; having no outlet through which they can issue forth to the open air.

To cure this evil, a species of ventilator has been lately contrived, by fitting a small circular wheel of metal into one of the upper panes of the highest window;—which is certainly of some utility, unless where it is attended with other inconveniences, which now require to be pointed out.

If a vent-hole is made in the roof of the room, through which the rarefied air may be readily emitted, it must follow, that as the air within the room is gradually heated, and thus carried off, some cool fresh air must insinuate itself into the
room

room to supply that deficiency, as well as to keep the fire alive : but if there is no vent for the heated air in the room but through the pipe of the chimney, there will be less danger that the smoke will be drawn from it into the apartment, than if there be another opening made for carrying off that heated air ;—so that any thing of this sort must have a tendency to diminish the draught of the chimney, and may on some occasions produce smoke, where it would not have appeared without it.

Every opening, therefore, of the sort here mentioned, ought to be so contrived, as to admit of being shut or opened at pleasure, so that a remedy may be at hand for this disease whenever it may become troublesome.—But the wheel-ventilators above alluded to do not admit of this, and are on this account imperfect.

There is no necessity for having that opening very large on any occasion, but it ought to be so formed as to admit of being easily contracted without being wholly shut ; which might be best effected by having the mouth of it covered with a sliding shutter, like that on the end of a telescope, which might be closed or opened to any degree at pleasure.

But if this pipe in the upper part of the room will have some tendency *in any case* to produce smoke, it will be rather in greater danger of occasioning this, if the fresh air is admitted to the
fire

fire by the pipes above described, than in the ordinary way.—For as the room, as well as the chimney, must in this case be in a great measure supplied with fresh air from these tubes, there would be some danger, that in issuing into the room it might draw some smoke along with it.—This danger, however, it must be acknowledged, is but very small,—next to nothing,—as all the fresh air that would flow from these into the room would issue at the under part next the hearth, where there would be no smoke.—What should go once through the grate, could never be drawn from the chimney, unless by extreme imprudence in allowing too great an opening in the roof of the room.

It would be better, however, on all occasions to obviate this inconvenience, small as it is, by the following contrivance which would render our apartments more sweet, wholesome,—equally warm in every part, and more agreeable upon the whole, than any other.

Let another opening be made in the ceiling of the room, having a communication with a small pipe that should lead from thence either to the outside of the wall, or to any other part of the building that might be judged more convenient; where it should be bent, and conducted downwards, till it reached the ground; where it should be left open, to communicate with the external air.—In this situation the cool external air would be

be forced in at the lower opening of the tube *, and made to ascend into the apartment, in proportion to the quantity that escaped towards the higher regions by means of the ventilator.—And as that weighty air would no sooner enter the room

* Such readers as have been little accustomed to speculations of this sort, will be at a loss to comprehend in what manner two holes, both of them in the roof of the room, and communicating with the air, without any valve, or other contrivance for opening or closing of themselves, should yet answer the two very opposite purposes, one of constantly bringing cool air into the room, without emitting any warm air, — and the other, of as constantly emitting warm and admitting no cool air.

They will please to advert, that the one of these tubes communicates with the atmosphere *at the bottom* of the house, and the other towards *the top*: — The opening of the one is beneath the level of the room, that of the other above it. — Now as the air is more dense at the surface of the ground than at any height above it, the warm rarefied air will naturally issue at that opening where it meets with least resistance, which must invariably be through that which opens to the external air at the greatest height; — and as the cool air will naturally be pressed into the room by that opening where the air is most weighty, this must invariably be by that which is nearest the surface of the earth.

than

than it would tend towards the floor by its own natural gravity, it would gradually mix with the heated air in its descent,—become in some measure warmed by that means, and equally dispersed through the room, so as slowly and imperceptibly to reach the candles and the company in the room, and supply them with a sufficient quantity of fresh and wholesome air, without the inconveniencies to which the company are subjected by the usual way of admitting fresh air. For, if it enters near the floor of the apartment, it is hurried along in a rapid undivided stream towards the fire-place, and striking upon the legs and inferior parts of the body, affects them with a strong sensation of cold. To overcome the effects of this, large fires must be kept; by which other parts of the body are warmed to an extraordinary degree, which is productive of most of those disorders that are pernicious to the young, and often prove fatal to the old, during the winter season, in these cold regions.

Thus might our apartments be kept constantly, and moderately, and equally warm, at a moderate expence, without endangering our health on the one hand, by respiring a confined stagnant, and putrid air,—or on the other hand, by subjecting ourselves to such danger of catching colds, consumptions, and rheumatic complaints, by being exposed to such exceedingly unequal degrees of heat and cold, as are unavoidable when our apartments are so open as to admit a ready passage to the external air during the winter season.

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The reader will easily perceive, that all that has been here said, has a reference only to those apartments in cold climates and rigorous weather, where fire to warm them becomes necessary.—In warmer regions, or during the summer season, there can be no objection to the wheel-ventilator in the window.—It is a simple contrivance, and a safe and effectual mean of preserving the air in our apartments sweet and wholesome at that season.

The importance of the improvement here proposed, will plead my excuse for the length of this seeming digression.—I now proceed.

2. A second cause of smoke is the wrong position of doors and windows with respect to the fire-places.

As the smoke is impelled up the chimney by the pressure of the air, if that air is driven away from the fire-place by any cause more powerful than the suction occasioned by the fire, the smoke must also be drawn away with it, and follow the same direction with that current of air; so that whatever tends to draw a current of air from the under part of the chimney, will also tend to produce smoke in the house; from whence it is easy to conceive how doors or windows may occasion smoke when the wind is in certain directions.

Thus, suppose a chamber, A B C D, Fig. 8. having a door or window at E, another at F, and a fire-

a fire-place at G; when the wind is in the direction D A, or C B, the general current of air will occasion a sort of suction at the opening E, so that the air will be drawn from the chimney G towards E; and if the current be strong, and the opening at E large, it will become more powerful than the suction of the chimney, and produce smoke in the apartment.

If the window at F should be opened in this case, it would not mend the matter; for any wind which should enter at F, would be carried straight out at the opening E, and the current of air would be drawn from the chimney as strong as ever.

If the window at E were shut, and the wind still continued in the same direction as before, the current of air rushing past the window would have a tendency to draw the air of the room along with it, and occasion smoke, but not so powerfully as if the window at E were open.

If the wind were in the direction D B, it would be in great danger of producing smoke; but if it blew in the direction C A, the case would be very much altered; for then a quantity of air being forced in at the opening F, and finding no ready passage, it would be pent up in the chamber, and force itself up the chimney with violence.

I omit mentioning what would be the effect if the wind were in other directions, as it is imagined these

these will be sufficiently obvious to every attentive observer.

It is only necessary here to observe, that as doors or windows are seldom so exactly made, as not to produce some effect, seeing they always admit some air even when shut, and often occasion smoke when the wind blows from a particular quarter; and as workmen and others generally apprehend, when houses are troubled with smoke in this manner, that it is occasioned by some external cause, and apply their attention to cure it, by altering the top of the chimney, which never can produce the smallest service in this case, I would recommend a more particular attention to be paid to the situation of doors and windows than is generally given, especially in situations where they are exposed to any violent current of air in a particular direction, as in narrow lanes, or defiles of any sort, where the wind, when in particular directions, is hurried along with a prodigious rapidity. And that the effects of different positions may be still more obvious, I shall produce several other examples.

Suppose a chamber, Fig. 9. having a door at A, and two windows, B, C, with a fire-place, D: if the wind came in the direction D A, and if the door transmitted as much or more air than was admitted at both the windows, a current of air would flow from all parts of the chamber towards A, and therefore would have a tendency to occasion smoke: but if as much or more air came in at
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the windows than could get out at the door, there could be no such current ; but, on the contrary, it would be forced up the chimney, and carry the smoke along with it : wherefore in this situation a room might sometimes be cured of smoke, by making the door as close as possible. Nothing could be more hurtful in this case, than boring a hole in the door. But if the house was in such a situation as to be more frequently exposed to wind which came in the direction of A D, it would run little risk of being troubled with smoke.

Suppose a room, Fig. 10. having a door at A, and two windows B and C, with a fire-place D. If the wind came in the direction C B, or B C, and both the windows were open, it is evident, that the smoke would be drawn from the chimney by the strong current of air passing through the room ; or if the window upon which the wind came were closed, and the opposite one open, nearly the same effect would be produced : but if the window upon which the wind blew were open, and the opposite one and the door shut, the room would be immediately cleared of smoke entirely. In this situation it is evident, that if the windows were badly made, so as to admit much air, it would tend to occasion smoke, especially if the door were in the same condition ; it is therefore of consequence to attend to this circumstance in a situation similar to this.

Having premised so much with regard to single rooms, I shall now proceed to consider a more compound

compound structure. Thus, let Fig. 11. represent a building consisting of two chambers, K L, joined by a passage. The chamber K having a door B communicating with the passage, a window F, and fire-place G; and the chamber L having a door C, another door or window D, the window E, and fire-place H; the entry to the whole being by the door A. Let us now consider what would be the effect of the wind coming from different directions upon this building.

And, first, suppose the wind blew in the direction A M. If all the doors and windows were close shut, and very little air were admitted, there would be little risk of smoke. But as there would surely be some admitted through these different openings, there would be some chance that the chamber L would be troubled with smoke; because some of the air that forced its passage through the chinks of the door A, would pass through the doors C and D, which might produce smoke in a small degree.

There would be little chance that the chamber K would smoke in this case; because although there is a general suction through the passage from B to D, yet as it is in some measure interrupted by the close door at C, it will be but small; and as the wind is interrupted in its course by the wall of the passage, some of it will be forced through the chinks of the window F, which would more than counterbalance the effects of the other suction.

D

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But if the door D were open, both the chimnies would smoke; especially if the doors B and C were open also, as the current would be then very strong towards that point.

In all cases the smoke of this house would be prevented, by keeping the door at D shut, and that at A open; but if the house was in such a situation as to be more exposed to that wind than any other, it would be better to close up the door D altogether.

If the wind more commonly came from M towards A, it is more than probable that a house situated like this would be quite free of smoke; as the general current of air would be towards the chimneys. The chamber K, however, would run greater risk than L, as the suction might sometimes be drawn towards the window F: but if the door A were in the opposite side of the passage, that inconvenience would be avoided also.

If the more general current of air were from K towards L, this house would almost of necessity be troubled with smoke, unless the windows were very close: but there would not be the smallest chance for that when it came from L towards K.

I might now proceed to give more examples of this sort; but as it would be impossible to enumerate all the variety of cases that might occur, it is imagined that these will be sufficient to give the reader an idea of the manner in which any building

ing ought to be examined in this respect ; and he must be left to his own discretion to apply the principles above explained to all the variety of cases that may occur. In large complicated buildings, it no doubt requires a greater extent of thought to combine all the various circumstances together, and draw a general conclusion, than in smaller and more simple ones ; but if the general rules that are given towards the conclusion of this treatise, be properly attended to, the complaints arising from this cause will be less numerous than at present.

S E C T I O N III.

Of Smoky Houses arising from a wrong position of the building with regard to external objects.

THE third general cause of smoke in houses is, the wrong position of the house with regard to external objects, which, by interrupting the course of the air, makes it assume various directions, and wheel about in eddies, so as to prevent it from ascending with ease from the chimney top, or beats it down into the room with violence.

This is more seldom the cause of smoky houses than either of the two before mentioned ; although it seems to be almost the only one attended to by the persons who pretend to cure smoky

houses at present, as most of their remedies are adapted to remove the disorders arising from this cause alone. I shall briefly point out the several cases in which this can occur, that every one may be enabled to judge for himself when these cures are proper or not.

The air (as has been said) is a fluid, and wind is a current of that fluid; which, when driven along the surface of the earth, flows with a smooth and equal stream, unless when opposed by some object that interrupts its course; but when it meets with any object that directly opposes its course, it is in some measure pushed back again, and made to spread on every side, towards which it flows with great impetuosity. It is likewise a fluid of considerable gravity, and therefore presses upon the surface of the earth with great force; so that when a current of it flows upon the surface of our globe, it has a tendency to move forward and press downward at the same time; from whence it happens, that when a current of air is forced over the top of any high object, the side of which descends perpendicularly towards the surface of the earth, the velocity of the current at first overcomes the gravity, and it flies a short way over in that direction; but the power of gravity acting upon the under surface, draws it downward, and in a short time overcomes the impetus that it had to rush forward, and occasions a sort of eddy nearly similar to what we see in running water behind a stone which interrupts the violence of its current.

To

To illustrate this more plainly, let A B, Fig. 12. represent a part of a high building, near to which is a smaller one C D; and let the dotted line E F represent a current of air flowing with considerable force in the direction F E. It is plain that it will flow straight forward over the top of the small building; but when it meets with the large object, it will be interrupted in its course, and spread itself on every side, as represented by the dotted lines G G, &c. and at last it will flow towards that place through which it can escape with the greatest ease. If the opposing object be large, and if there be no opening through which it can issue near the ground, then it will ascend to the top of it, and flow off in that direction, carrying the smoke that ascends from the small chimney C along with it: but if there is any opening below, either a street or a lane, or any other passage that will admit the wind to pass, then will the natural gravity of the air draw the general current downward to flow off through the lower passage; in which case, the smoke which ought to ascend through the chimney C, meeting with a current of air opposing its passage, will not be at liberty to issue forth, but be forced back again into the room from whence it proceeded, unless some contrivance is fallen upon to prevent it.

Again, let A, Fig. 13. represent a small building at the side of a great rock B, and the wind coming in the direction C D; when the current of air comes to the point D, having hurried forward with great velocity, it goes a little forward; but soon

soon declines downward, and gradually is inflected more and more inward, as represented by the dotted lines E E, &c. so that pressing downwards upon the top of the chimney A, the smoke is beat back again into the apartments. Thus it is that low houses when contiguous to high objects, are in danger of being disturbed with smoke.

If the contiguous object be not very high, the disorder may be cured by heightening the chimney of the low house : but if it is very high, it will be necessary to cover the top of the chimney in such a manner as to prevent the wind from entering it, at the same time that a passage is left at some of the sides through which the smoke may issue with freedom. Many are the contrivances that have been invented for this purpose, which are to be met with every where ; and as there is no difficulty in accomplishing the desired end, by an infinite variety of methods, every one who needs such a thing may please his own fancy in the choice. I have thought it unnecessary to add any more but one kind of these, Fig. 14. which will answer the end effectually.

It is evident that houses situated near high hills, or thick woods, will be in some measure exposed to the same inconvenience ; but it is likewise plain, that if a house be situated upon the slope of a hill, as at Fig. 13. it will not be in any danger of smoke when the wind blows towards that side of the hill upon which it is situated ; for the current of air coming over the house-top in
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the direction $G H$, is immediately changed, by the slope of the hill, to the direction $H C$, which powerfully draws the smoke upward from the top of the chimney. But it is also evident, that a house in this situation will be liable to smoke when the wind blows *from* the hill; for the current of air coming downward in the direction $C H$, will beat downward on the chimney F , and prevent the smoke from ascending with freedom. But the effect will be much heightened, if the doors and windows be chiefly in the lowermost side of the house.

These are some of the most general circumstances which prevent the free ascent of smoke, arising from external objects: but there are many other lesser causes that may at times occasion smoke, all of which it would be tedious to enumerate; such as, blasts of air reflected from the sides of mountains, and coming down valleys with great impetuosity, occasioning, in particular situations, eddies or whirlwinds of different sorts. In short, whatever in any measure disturbs the free motion of the air, is in danger of producing sudden gusts, which may occasion smoke. Therefore, whoever builds in a situation that is not altogether free, may lay his account with having some sudden gusts of smoke, unless he forms the top of his chimney so as to obviate it. And there are some situations so much exposed to sudden gusts of wind, which is sometimes whirled round, sometimes beat suddenly downward, or as suddenly carried up again, that it is difficult to guard against every danger. In these

these situations I would recommend something of the form of what is represented at Fig. 15. which would be proof against every wind whatever.

But altho' all the circumstances that occasion smoky houses may be reduced to one or other of the three general classes above enumerated, it may be proper to observe, that, in many cases, two or more of these defects may be combined together, so as to augment the malady ; which tends greatly to perplex those who may attempt to cure houses that are troubled with smoke. It therefore behoves every one who shall attempt this task, to habituate his mind to reflect on this subject, so as to be able readily to combine or separate all the phenomena belonging to each of the classes in his own mind. To enable him to do this more readily, the following rules will be of use.

Short and easy rules, by which the different classes of Smoky Houses above mentioned may be distinguished from one another.

1. **I**F this disorder arises from a fault in the construction of the chimney itself, the house will be pestered with smoke almost continually, especially in calm weather.

2. If the house is not troubled with smoke in calm weather, or only when the wind comes from some particular quarter, and can then be cured by opening some door or window, the fault may be looked for in the distribution of the doors or windows

dows of the house. The only case in which there is a difficulty to distinguish whether it is owing to the fault of the chimney or the house, is when it proceeds from too much closeness of the apartment. But this may be easily known by trying it in a calm: for if it proceeds from this cause, there will be no smoke in a perfect calm, if the doors are left open; whereas if the defect proceeds from a fault in the chimney itself, it will still continue to smoke in calm weather, even when the doors are open.

3. When the smoke is occasioned by external causes, these can be in general seen; but it may be likewise known by this, that it descends in sudden puffs with great violence at times, even when no change is produced either by opening or shutting doors or windows.

By attending to these few rules with care, there will be little danger of mistaking the cause from whence this disorder proceeds.

I shall now make a few observations on some particular cases which can hardly be reduced to any of the foregoing general heads.

Anomalous Cases.

1. **I**T sometimes happens, that the smoke is prevented from ascending with freedom, by having a small part of the top of the chimney broke down, so as that some parts of it remain higher than

than others, which in some measure reduces it to the state of a chimney at the side of a higher one.

To prevent this, it is always proper to have the top of the chimney finished with stones neatly cut and firmly built. It is not to be doubted but that those things which are placed upon particular chimneys with a view to cure them of smoke, do often, from the same cause, hurt the neighbouring chimneys built in the same wall.

2. A chamber is sometimes filled with smoke, when a fire is kindled in a neighbouring chimney, and none in it, although there is no appearance of smoke when it has a fire burning in its own grate.

This may sometimes proceed from a small hole breaking through the thin partition that divides the two chimneys from one another; and as smoke is a weighty body, which is only buoyed up by the warm air which passes through the fire, when it penetrates into the cold chimney it naturally subsides, and comes down to the chamber with which the chimney communicates, when there is no fire to carry it off.

But this disease is generally produced by the smoke entering at the top of the chimney, and descending into the adjoining apartment along with the cool air that is forced down the tube by some accidental suction of air in the house. If this last

is the case, it may be cured on many occasions, by setting a pretty high stone at the top of the chimney, as a division between each two: but the surest method, in all cases, is to have a smoke-board exactly fitted into the chimney above the grate, or an apparatus like that described above, p. 32. which on all occasions effectually prevents it.

3. It frequently happens that a chimney does not carry off the smoke well at first when the fire is kindled, although there is not the smallest tendency to it at other times.

This proceeds from the narrowness of the chimney: for when the fire is kindled, the whole tube is filled with cold air, as weighty as that in the apartment; and being expanded by the fire at the bottom, it endeavours to ascend to the top; but being pent in by the narrowness of the tube, and pressed by the column of cold air above, it is some time before it can wholly overcome that resistance, and some of it is forced into the chamber, till by degrees the whole chimney is heated, and then it vents quite well.

If the smoke produced by this means is not very troublesome, it may be borne with; but if it be extremely disagreeable, it may be cured by having a sheet of milled iron, large enough to reach between the two sides of the fire-place, and as deep as to reach from the mantle to the grate, or lower, which might by any contrivance be hung
up

up before the fire at that time, to act in some measure as a *smoke-chimney*. This would quickly make the fire burn, and carry off the smoke entirely. After that is effected, it might then be removed till another occasion.

That this treatise may be as complete in itself as possible, I shall subjoin some hints to inexperienced architects, by attending to which many of those inconveniencies may be avoided, to which people of moderate fortune in the country, and in a particular manner clergymen of the church of Scotland, are often subjected from the unskilfulness of those who on these occasions usually perform the double office of architect and mason.

Hints to inexperienced architects, to enable them to distinguish and guard against those circumstances that have a natural tendency to occasion smoke, whether these arise from the position or internal division of the house.

1. **I**N general, study to have an equal number of openings, such as doors and windows, on each side of the house, unless in the cases that may be afterwards excepted.

2. Endeavour to prevent, as much as possible, a free passage between the openings in the one side of the house and those in the other side, which always occasion a current of air within the house, that will be in danger of producing smoke.

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The best method of obviating this inconvenience, is to build the house of such a width as to admit of two rooms a-breast, or what is called a *double house*; and in this case avoid having doors opening from the one room directly into the other, which will in many cases occasion smoke where it would not otherwise have been.

Circumstances of this sort are seldom adverted to; but as it is of importance to call the attention of the reader to every particular that may have any influence in producing or dissipating smoke in houses, I shall relate a case of this sort that occurred to myself.

I had once occasion to hire a bed chamber for some time; and having found one that suited me very well, I took possession of it: — but after a few nights I found myself seized with a violent cough; and having been kept awake by it in the night-time, I was surprised to find a stream of cold air coming through the curtains at the back of the bed. — Anxious to discover from whence this proceeded, I drew the curtain aside; and was much surprised to see light coming through a great hole in the partition, lower down than the bedstead which having been close to the wall, concealed it from my view before.

Upon complaining of this to my landlord, I learned that the light proceeded from the kitchen, which was divided from my apartment by a single partition; and that as the kitchen was much infested

fested with smoke, the servant was in the custom of opening a back window at bed-time, from whence proceeded the cold air that had incommoded me so much.

Orders were immediately given to close up the hole in the partition; which was done the same day; and I quickly got the better of my cold, nor thought more of the matter.

But in a few days the landlord surprised me, by thanking me for the favour I had done him, by causing the hole in the partition to be closed up; because ever since that time his kitchen had been perfectly free of smoke. I remained in the house for some months after; nor was it once in all that time infested with that terrible nuisance.

3. If circumstances do not render it eligible to build a double house, as it is commonly called, — avoid making windows in opposite directions in the same apartment; but make the windows of some of the rooms wholly on one side of the house, and those of the other rooms wholly on the opposite side, which will preserve the necessary balance, and prevent, in some measure, the violent suction of air between them.

4. Avoid long passages as much as possible; as these always occasion a disagreeable suction of air, that is often productive of smoke.

5. For

5. For this reason, it is always better to contrive matters so as to have the kitchen, cellars, &c. under the same roof with the dwelling-house, than in other detached buildings, by way of wings to it;—a practice for which the inhabitants of Scotland, in general, seem to have a very unreasonable predilection, although it is attended with many inconveniencies besides that we now wish to obviate.

6. But if wings must be had for ornament, let them consist of such buildings as have no necessary connection with the house, and that have no internal communication with it.

7. Or if circumstances make it necessary to have the kitchen, &c. as wings, let them communicate with the house, if possible, only by the principal entry.

8. If long passages cannot be avoided entirely, endeavour, if possible, to have no openings at either end of these passages; and never let them terminate in an open apartment, in which there is a fire-place, — in a stair-case, — or in any place that has a free communication with the higher parts of the house.

The entry from without to these passages, ought to be in one place, near the principal stair-case; and all other parts of them ought to be as close as possible; which will prevent many of those inconveniencies that usually attend them. But,

9. If

9. If there must be openings at the ends of these passages, always make both the openings in the same side of the building, so as that the wind may blow into both at the same time : for if they are otherwise placed, there will be a brisk stream of air flowing through them continually ; but this will be somewhat diminished if they are placed as is here directed.

It is no exception to the above rule, to observe, that if two buildings project from the body of the house by way of wings, and if there is an open passage communicating from the one to the other, terminating in a door at each end, in that case both the doors ought to open into the inner side of the court, fronting each other.

10. Contrive matters so as to have only one principal-entry-door, which should open directly into a close landing-place, that has no immediate communication with the stair-case, or common passages through the house, unless these passages are quite close at each end.

11. In houses of a moderate size this may be easily practised.—In larger buildings, where it is necessary to have a separate entry for servants, this entry ought in general to be on the same side of the house with the principal entry, in an under floor. — Nor ought there to be any direct communication between that entry and the principal landing-place above stairs : — for this communication ought only to be through passages, with doors upon them,

them, always shut, unless when occasionally opened.

12. In such houses, the stair-case from the servants flat, to the principal floor, ought to terminate in a close landing-place, communicating with the principal apartments, passages, and stair-case, through doors opening into each.

13. The stair-case ought to be made as close as possible on all sides, especially towards the top; where it ought on no account to have a free communication with the garrets, or with the ceiling of the house; for these are usually so open and airy, as would occasion a constant suction of air between the lower apartments and them. — The entry to the garrets and ceiling should be from some part of the highest floor, that does not immediately communicate with the principal stair-case.

14. Although the principal entry to the house is usually determined by the situation of the ground on which it is placed; yet, if all other circumstances are equal, smoke would be most effectually prevented if it were made to front that quarter from whence the wind blows most violently for the greatest part of the year. But,

15. If the situation does not admit of this, care ought to be taken to place rather a greater number of windows upon the windy side than the reverse; which will counterbalance the inconvenience that may arise from the door being wrong
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placed. The door in this case ought to be made to shut extremely close, and be otherwise guarded, as shall be mentioned by and by.

16. If a house is built upon the side of a hill, or any long declivity ;—for the sake of symmetry, and in compliance with established custom, the front must be towards the foot of the hill ; altho' this, of all the positions that could be chosen, is aptest to produce smoke.

17. Sometimes the entry for state may be made in that front,—and another entry for common use made in some other part of the building, which may in some measure obviate the inconvenience,—especially if there is no direct communication between the two entries, and if the principal door for state be made to shut extremely close. — But if there be a direct communication between the two doors, the whole house might be filled with smoke in a few minutes, when the grand door was opened while the wind blowed down hill.

18. To obviate this inconvenience, —in all situations where the entry of a house situated upon a long declivity, is on that side that looks towards the valley below, — great care ought to be taken, not only to have the principal door to shut as close as possible, but to have it further secured by a close portico without, if it does not open into a perfectly close lobby, or landing place, within the house. All the doors that have any communi-
cation

cation with this, ought to be so constructed as to close with the most perfect exactness, and to shut of themselves, to prevent the disagreeable consequences of accidental carelessness.

In many instances the moderns have improved very much on the practice of their predecessors; but in some cases useful inventions have been neglected, and suffered to fall into total oblivion.

A striking instance of this sort occurs to me just now which deserves to be pointed out. In a very old building that I happened once to be in, I was surprised to find, that all the doors in the house not only moved upon their hinges with the greatest sweetness, but, if carelessly left open, always closed of themselves, although in the most gentle, and imperceptible manner.

Upon endeavouring to investigate the cause of this agreeable phenomenon, I found, that the hinges, instead of being constructed in the modern way, of having two pipes alternately inserted into notches cut out for that purpose, with a pin passing through the whole were fashioned upon the old principle of *crooks* and *bands*, as they are usually called, which kind of hinges are still used for hanging gates and very weighty doors.

What might be called the *band* in these hinges, was made of brass, and the *crook* of iron or steel.

The lowermost of these *crooks* consisted of a plain piece of iron turned exactly round, of the size of an ordinary goose-quill, which was bent upwards, and received into a hollow in the brass *band*, exactly fitted to it. This was between three and four inches long.

But the uppermost *crook* was cut into the form of a male perpetual screw, in fashion like the screw of a common jack, but a much smaller size, which was received into a female screw exactly fitted to it in the inside of the brass band.

In consequence of this form of the hinge, it happened, that when the door was opened, the female screw turning upon the male, necessarily raised the whole door higher and higher from the floor the wider it was opened;—and as brass moves always sweeter upon iron than any thing else, the door moved upwards very easily.

It also necessarily followed, that where the door was left to itself by its own weight pressing downwards upon the turns of the male screw,—the only thing that kept it from the ground, it slowly began to sink, and of consequence to turn the door round to its former position, so as gently to shut of itself.

These doors, as was the fashion formerly, were massy and weighty,—and the screw did not rise very suddenly upward,—so that all the motions were slow, but certain. The same effects might be produced, although in a less perfect manner, by lighter doors,

doors, if the screw were made to rise more suddenly.

The locks were made with weak well-tempered springs, which easily yielded to the pressure of the door, and shut without any sort of violent or clanking noise.

I cannot imagine any contrivance of a hinge more perfectly adapted for convenience and utility than the above; and it appears to me not a little extraordinary, that an invention possessed of so many advantages, should have ever been allowed to sink into oblivion. One would imagine, that the luxury of modern times, which so greedily searches for every refinement, would not have neglected this one.

How many inventions have been made for closing the doors of delicate persons;—but in vain;—The top and sides are covered with lifts of cloth, to prevent the lifting airs;—but the bottom is never perfectly closed:—Fashion says, the floor must be straight;—no bar must come across to close it from without;—the carpet must not be disturbed within;

The common contrivance, for making the door to swim a little as it opens, is awkward and clumsy indeed, in comparison of this one: for by this fashion of hinge, it is very practicable to make the door press with its whole weight upon the floor when it is shut, so as perfectly to exclude the air,
by

by nailing a list along the bottom of the door, and to rise upwards as it opens, so as to swim free of the carpet entirely.

But it is of still greater use when applied to outer doors, that are exposed to the weather.

All outer doors must open inwards,——If they are not made to press very close upon the threshold, the wind beats in the rain below the bottom, so as to set the house a swimming.——Nor is it possible to make wood join so close to stone, but that some water will be forced in while the wind beats strongly upon the door;——and as it is impossible to raise the floor immediately within the threshold, while the door is hung in the ordinary manner, the water, when once forced in, can never go out again of itself, but must spread through the house, unless it be carefully dried up.

But if this fashion of hinges were adopted, the door could be made to press as close as possible upon the threshold, and the floor might be gently raised within, so as to allow the water that might be accidentally beat in, to flow out of itself;——notwithstanding which the door would move with perfect freedom.

Add to this, that the doors would always gently close of themselves, without any thing of that dangerous vehemence, or disagreeable clanking, that attend every other contrivance I have seen for that purpose; and I think we ought to be satisfied

tified, that this useful invention ought again to be revived ; especially for outward doors, and doors for passages, in the situation I have described above.

I hope the usefulness of these hints will plead my excuse for this digression. I now return.

19. Avoid making small rooms as much as possible ; for these are always much more liable to be troubled with smoke than such as are of a larger size.

All room-doors open inwards, so that when the door is opened, it presses upon the air within the room, in some measure like the leaves of bellows, and pushes it backwards, so as to force it into any passages it may meet with leading from the room. — But when it is again closed, it makes a temporary kind of vacuum in the room, so that the air rushes back again into the room through those passages that communicate with it from without.

Of the truth of this observation any one who has an opportunity of seeing a room that has two doors opening into it, may easily satisfy himself experimentally : for if one of the doors be left loose, and the other be opened pretty quickly, the door that is loose will be pushed forward by the pressure of the air so as to close ; — but when the other door is closed, it will be again pushed back, and remain open. This experiment may be repeated as often as you incline, without ever failing.

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In consequence of these contrary motions of the air in a room, produced by the opening or shutting of a door, it invariably happens, that when the room-door is opened, a greater quantity of air is forced into the chimney than usual;—and when the door is again closed, the air is drawn backwards from the chimney into the room, in greater or smaller proportion, according to particular circumstances; which has always a natural tendency to produce a puff of smoke.

These effects must take place in some measure in all kinds of apartments; but it is sufficiently obvious that they will be more or less sensibly felt in proportion to the size of the room:—for, in a small room, the quantity of air displaced by the door, bears so large a proportion to the whole contents of the room, as must occasion a very sensible pressure upon it, and force a great proportion of air up the chimney with considerable violence, when the door is suddenly opened, the want of which must be again supplied from the chimney by a similar violent suction of the air downwards, when the door is shut; which almost infallibly brings a considerable quantity of smoke along with it.

But when the room is large, the quantity of air displaced by the door as it is opened or shut, bears such a small proportion to the whole, and is usually at such a distance from the chimney, as to produce no sensible effect.

It is almost superfluous to observe, that the same effects will be produced, by opening or closing a press-door within the room, as by opening the room-door, in a still higher degree, in proportion to the size of the door of the press.

It is likewise sufficiently obvious, that when any person moves through a room, the air must be displaced by the body of that person, so as to produce an effect of the same sort, in proportion to the size of the body :—for when one moves towards the fire-place, a quantity of air is pushed before his body towards it, and forced up the chimney ;—but when he retires from it, a proportional quantity is drawn down the chimney to supply the vacuum left by the retiring body.

In a small room, the size of a human body bears such a proportion to the whole contents, and all the motions must necessarily be so near the fire-place, that it is hardly possible for a bulky person to move about in it quicker than a snail, without disturbing the suction of the chimney, and occasioning puffs of smoke ;—but in a large apartment, a perfect freedom of motion is allowed to every person in it without the smallest danger of producing any of these disagreeable effects.

On these accounts, were there no other reasons for it, those who wish to live comfortably in their houses, ought with care to avoid small rooms.

But
 all depends much on the nature of the fire
 and the situation of the chimney.

But small rooms are attended with so many other inconveniencies, that it is amazing mankind should so long have tolerated them.

A fire is no sooner fairly kindled in a small apartment, than its influence is strongly felt in every corner of it. — The small quantity of air it contains, is suddenly so heated as to become altogether insupportable; so that those who sit in it are broiled in an intolerable degree,

But that fire is hardly abated in its vigour a few minutes in a cold climate, when a small quantity of warm air, that was in the room is carried off through the chimney, and its place supplied by the cold air from without; so that it becomes in a short time as insupportable for the intense degree of cold, as it was a short while before by its extraordinary warmth. Thus the persons who inhabit such apartments are alternately exposed to the most sudden and violent extremes of heat and cold, which cannot fail to be attended with the most fatal effects to persons of a weakly constitution.

Even when the fire is burning with its greatest fervor, the door is no sooner opened, than a blast of cool air pervades almost the whole room, and chills those parts of the body that are not exposed to the immediate influence of the fire.

And although the door should not be opened, the cold air that is constantly drawn through the different

different crannies of the room to supply the waste made by the fire, having such a short passage between these crannies and the fire-place, is heated but in a very small degree, by mixing with the warm air of the room in its passage, so that it acts with great force upon those parts of the body that it meets with in its way, and cools them to an intolerable degree. In such a situation, a man to be properly warmed, would need to be turned round before the fire, like a quarter of mutton when it is to be roasted.

The same inconveniencies are felt if it is employed as a bed-room.—If the fire is vigorous at bed-time; it will be then too hot;—but no sooner is that diminished, than the whole room is instantly filled with air as cold as that without doors! —A leg or an arm accidentally exposed for a very short time, is seized with the most violent rheumatism.—The very air that is necessary for respiration, becomes so cold as to be uncomfortable; which frequently tempts weakly people to cover themselves so close, as, before morning, to breathe in an atmosphere of foul air, deprived of its vivifying force by being frequently respired, which is of the most noxious quality, and is often productive of the most fatal disorders.

These are some of the necessary and unavoidable consequences of living in small rooms; all of which disagreeable effects might be entirely prevented, by having larger and more airy apartments.

In this case it takes some time for a fire to heat the whole air of the room;—no part of which can ever become so hot as in one that is smaller, because it has greater freedom to expand itself, and mix with the cooler air in other parts of the room.

And as a great body of air is thus heated in a moderate degree by the continued action of the fire while it lasts, it is long before all that heated air can be carried off, even after the fire is extinguished; so that the vicissitudes between heat and cold, are neither so sudden nor so violent as in the other case.

The opening a door in an apartment of this sort, has also a much less sensible effect upon those who are in it, as the cool air that enters, gradually mixes with the warm air in the room, and in its longer passage before it reaches the company, is so much blended with it, as to be hardly sensibly perceived.

Still less sensible will be the effects of the air that insinuates itself through the crannies of the room to supply the fire;—so that those who are in such an apartment, enjoy a much more temperate and equable heat at all times, than those who inhabit smaller rooms; and are, of consequence, much less exposed to the disorders that arise from these causes.

And

And in bed-chambers the difference is the same: for the moderate heat they enjoy at bed-time is only agreeable; and it has not time to be so much abated before morning, as to be productive of those bad effects that must be experienced in smaller sleeping rooms.

On all these accounts large apartments for all purposes cannot be too much recommended: nor can the prevailing taste among people of moderate fortune having numerous small rooms be defended on any other principle, but that species of vanity that annexes an idea of gentility to the possession of numerous separate apartments.

If a man of a moderate fortune had larger rooms, and fewer in number, he could live more at his ease himself;—because a much smaller quantity of fuel would warm one such room, and keep it constantly heated to a proper degree, than can warm different rooms in which fires are only lighted at times.

It would be much more comfortable to his guests;—because, instead of being entertained in a room where they were obliged to be either roasted or frozen alternately, they could enjoy a temperate, uniform, and agreeable degree of heat.

If instead of a bed-chamber for every guest he may have in his house, in each of which fires can be but seldom lighted, and in which the guest of course runs a risk of meeting with damp bedding, and an
ill-

ill-seasoned room,—to say nothing of the other inconveniencies above mentioned,—he had fewer bedchambers, and these larger, with perhaps several beds in each;—as frequent fires would be lighted in these,—and as the rooms would be more airy of themselves, the bed would be in much less danger of being ill-seasoned or damp than in the other case;—and as the landlord would have fewer fires to kindle, he would have it in his power to afford his guests more comfortable and wholesome lodgings than he could do in the other way.

Whether the modern ideas of gentility, and elegance of living, will permit the advice above given to be followed, I very much doubt;—but the inconveniencies that are felt by travellers, and others who visit much in the country, arising from this cause, are so great, and are attended with such dangerous consequences, as ought to make it be attended to.

20. If there are strong partitions in the inside of the house, endeavour to have as many chimneys as possible in these partitions.

In other cases endeavour to have the chimneys, in general, on that side of the house towards which the wind blows seldomest.

21. If the house is placed upon a considerable declivity, endeavour to throw the wings, if it has any, towards that side which is higher than the house.

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In such a situation it will, in general, be adviseable to break the force of the wind, by planting some trees, hedges, or brushwood, at a reasonable distance from the house towards the top of the hill.

By attending to these cautions, and the directions given for constructing the chimneys properly, there is little reason to fear that any house will be troubled with smoke.

And it will give the author a sensible pleasure, if he can flatter himself with the hope that this small treatise may be the means of freeing numbers of his fellow-creatures from being pestered with this terrible nuisance.

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